Smoked Out:
Impact of Wildfire Smoke on Labour and Buildings

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This paper: acute wildfire smoke exposure reduces demand for office space

- **Main result:** increased wildfire smoke results in lower office rents, shorter lease terms, and lower local employment (higher unemployment rates)
  - Heterogeneity: results driven by areas newly exposed to severe wildfire smoke and by older buildings (adaptation?)
  - Builds on results by co-authors (Cvijanović, Rolheiser, Van de Minne 2024 *REE*) showing air pollution lowers NOI and property market value ✓
  - IV approach: instrument air pollution with # of heavy smoke days $\longrightarrow$ fall in CRE value $\downarrow$ due to reduced worker productivity
- Complements results in the literature showing that wildfire smoke reduces...
  - Worker earnings, employment, labor force productivity (Borgschulte, Molitor, Zou 2024)
  - Home rental prices in large metro areas (Lopez & Tzur-Ilan 2023)
- Effects are **persistent** to the extent that office leases are long (5 to 10 years)

Comment #1: employment vs. productivity effects

- Current analysis focuses on employment (or unemployment) but argues that rents fall due to a neg. effect of smoke on labor force productivity (LFP)
  - **Exclusion restriction:** heavy smoke days influence rent/employment only through pollution-induced reduction in demand
  - Other possibilities (GE): hedonic tastes change, salience effects, migration $\longrightarrow$ more systematic discussion needed for causal interpretation
- **Construct more direct measures of county-level productivity**
  - Census Quarterly Workforce Indicators (QWI) has value-added per worker ($Y/L \propto$ MPL)
- For listed firms, should be able to construct Y/L by matching Compstak tenant roll to Compustat fundamentals or Dun & Bradstreet plant-level data
- Similar results found in corporate temperature shocks literature using plant-level data merged to balance sheets (Addoum, Ng, Ortiz-Bobea 2020,23)

Comment #2: isolating adaptation responses

- **Cool new result in this paper that neg. effects of smoke concentrated in markets which used to have clean air**
  - Authors argue this is due to adaptation of markets b/c pollution externality already neg. capitalized into rents in areas with a history of smoke
- **Natural alternative explanation is that physical adaptation responses play a role**
  - Use autocorrelation in CAPX vs. OPEX patterns to tease out history of possible retrofits to separate out the two types of adaptation
  - Construct proxies using energy certification or merge with publicly available permits data for larger markets
- **"Healthy Buildings"** HBS case studies showing worker productivity spillovers render retrofits NPV > 0 when they o/w wouldn't be if not for tax incentives
  - See Ch. 4 Allen & Macomber (2022), *Healthy Buildings*, Harvard University Press

Example of a "healthy buildings" pro forma

- Take a standard mid-sized office tenant ($\approx$ 50 employees)...
  - Consider change to office air filter system
  - Assume modest 2% worker productivity gains in line with public health research (e.g., Milton, Glencross, Walters 2001)
  - **25x larger gains** than those from standard energy-efficiency measures like solar
- Still large returns if reapportion costs among tenants as common area maintenance (CAM)

TABLE 4.5 Pro forma income statement for HB—all costs and benefits included.

BASELINE COMPANY ASSUMPTIONS	
Number of Employees	40
Average Salary	$75,000
Payroll as % of Revenue	50%

(X) WHAT IF?	IMPACT
OpEx Cost (energy)*	**$40/person/yr**
Payroll Effect: Health	–1%
Revenue Effect: Productivity Boost	2%

**Bolded item is new in this model*

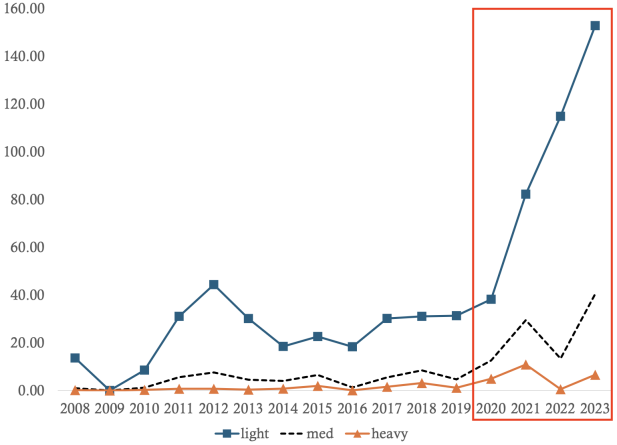
(X) ITEMIZED IMPACTS OF HEALTHY BUILDING DECISIONS

	Baseline	OpEx Impacts	Payroll Effect: Health		Productivity Boost: Health		Baseline + Healthy Buildings
Revenue	$6,000,000				2%	$120,000	$6,120,000
Payroll	$(3,000,000)		–1%	$30,000			$(2,970,000)
Rent	$(300,000)						$(300,000)
Utilities	$(30,000)	$(1,600)					$(31,600)
Other Expenses	$(1,000,000)						$(1,000,000)
Net Income before Taxes	$1,670,000						$1,818,400
Taxes (30%)	$501,000						$545,520
Net Income after Taxes	$1,169,000						$1,272,880
Change							*8.9%*

Comment #3: influence of COVID and WFH norms

- Heavy smoke days overall fairly uncommon prior to 2020
  - WFH is the other big shift in office CRE post-2020 $\longrightarrow$ historical exposure appears negatively spatially correlated with WFH propensity (Dingel & Neiman 2020)
- **WFH might impact interpretation of the results for two reasons:**
  1. **Feedback loop:** air pollution might nudge companies towards WFH policies, which in turn reduces their demand for space (static vs. dynamic effects)
  2. **Identification:** if unrealized concerns about smoke move companies further towards WFH/hybrid modality, then exclusion restriction fails
- **Do early lease terminations spike after severe wildfire smoke events?**
  - If so, conditional on WFH norms, penalty values from breaking lease would allow you to isolate firms' willingness to pay to protect workers' health/productivity
  - Important parameter given push to integrate ESG concerns into pro forma analysis for evaluating gains to retrofits such as air filtration systems

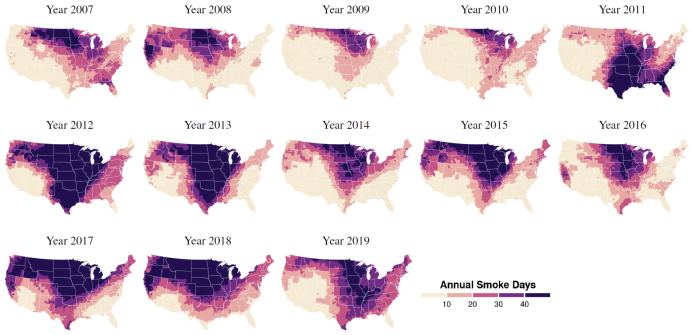
Is the time series or cross-sectional variation driving drop in demand for office space?



Note: The average smoke days per county per year. The vertical axis gives the average smoke days, and the horizontal axis provides the years. (Based on EPA data.)

- Most of the effects are driven by heavy smoke episodes
  - Very rare occurrence prior to 2020
  - Show separate results splitting sample by pre vs. post-2020
- Also, define the categories since these are taken from NOAA
  - What is the difference in salience (e.g. orange skies in NYC) vs. health consequences among the categories?

Less spatial variation in smoke in pre-2020 period



Source: Borgschulte, Molitor, Zou (2024), "Air Pollution and the Labor Market: Evidence from Wildfire Smoke," *Review of Economics and Statistics*

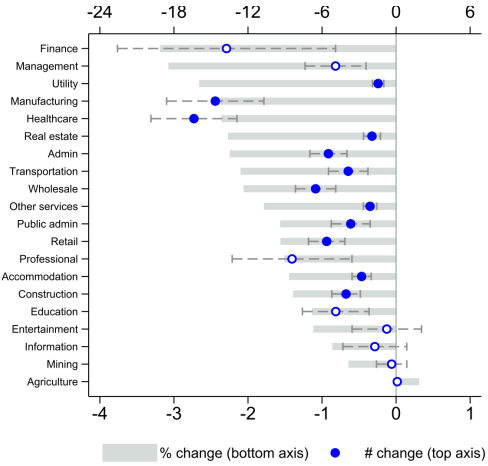
- Show heatmap of spatial exposure over time by light/medium/heavy designations
  - More information in the text on how these categories are defined
  - Was exposure concentrated in sparsely populated areas in the pre-2020 period due to the "shocks" being driven by CA wildfires blowing into the Great Plains?
    - ★ If so, big differences in impacted properties in early vs. late part of sample

Where are tenants going instead?

- Drop in quarterly employment mirrored in rise in monthly unemployment rate after counties exposed to wildfire smoke
  - Important to emphasize because it implies firms not simply shifting to WFH regime
  - But is increased smoke exposure causing net job loss at the firm level?
  - If so, climate change adaptation of CRE can help stabilize the labor market

- **"Nearest-neighbor"** approach matching counties within each heavy smoke event to proximal, relatively unaffected counties with similar office space availability
  - If no net layoffs among tenants, should see an uptick in leasing, rents, and employment in alternative counties $\longrightarrow$ flight to climate havens
  - If null effects, then wildfire smoke is displacing workers
  - Effects likely heterogeneous across tenant industry (e.g. tech jobs more difficult to staff outside the Bay Area) $\longrightarrow$ within-firm labor flows?
  - Based on previous work by the authors, seems that sufficient variation should exist to identify counterfactual labor markets

Heterogeneous effects on office CRE by industry?



Source: Borgschulte, Molitor, Zou (2024), "Air Pollution and the Labor Market: Evidence from Wildfire Smoke," *Review of Economics and Statistics*

- Is there similar heterogeneity in rents, office valuation by the industry classification of the parent company?
- Related: does **tenant diversification** within the property matter?
  - From landlord's perspective, may be a new consideration for projecting cash flows and risk of tenant turnover
- Not obvious which direction effects go
  - Effects on earnings generally larger for subsectors with low WFH propensity
  - But commuting times (and therefore health exposure) within a CZ will likely differ across industries

Summary & policy implications: is climate change accelerating the CRE doom loop?

- Authors have done a great job showing that wildfire smoke has negative consequences on local labor market through demand for CRE
  - Paper therefore fills in the "first stage" of the authors' prior work showing CRE value lost from smoke exposure $\longrightarrow$ confluence of climate change and WFH shocks
- **Main suggestion:** dig deeper into labor market spillovers – within tenant and across counties – to elevate contribution relative to the authors' prior work
- **Policy implications:** high marginal value to climate retrofits in terms of firm productivity and stabilizing the labor market
  - Modern filtration systems are not costly relative to other green retrofits like solar and benefits likely realized sooner
  - Natural synergies with other policies (e.g. C-PACE) designed to provide cheap financing for green CAPX which substitutes for equity in the capital stack

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THANKS!